Easing the way to installing the next generation optical transmission platforms (SONET)

White paper

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Introduction

What are the pressing issues for success in today's telecommunications market? The ability to leverage and optimize existing network infrastructure is certainly one; the ability to rapidly deploy data services while protecting high-margin voice services is definitely essential; and the ability to economically transport mass amounts of traffic from the user to the core is undeniable.

Delivering these business fundamentals has led to the introduction of a new breed of SONET/SDH network platform: a platform that allows switching, aggregation and grooming of traffic within the same network element. However, installation of these platforms presents new test challenges. Indeed, a paradigm shift from traditional test methods is required to test these new platforms comprehensively and efficiently. So, what attributes should a test solution deliver? Quite simply, to simultaneously monitor the performance of all network traffic within a single test. Before examining the new test methodology though, let's look at what's driving network evolution.

What is driving network evolution?

Service providers currently generate over eighty percent of their revenue (and an even higher percentage of net margins from TDM-based traffic) from predominately voice traffic. Around seventy percent of the traffic crossing the network in 2000, however, was packet-based, a statistic that now surprises few. With voice traffic expected to remain constant, the delta between the mix of voice and data traffic on the network is forecast to widen unceasingly as bandwidth-hungry applications continue to grow.

How do service providers protect their high-margin TDM services yet prepare for network growth (and evolution) as packet-based traffic continues to grow at an unprecedented rate? The answer, in principle, is simple: to make bandwidth both cheaper — that is, reduce the cost per bit — and more manageable. In other words, the key to future success is the ability to efficiently aggregate, groom and transport data traffic over the Metropolitan Area Network (MAN) and onto the core network where bandwidth is inexpensive and virtually unlimited.

To thrive in today's competitive multi-service market, service providers require:

- Cost-effective and efficient multi-service modular systems that do not disrupt existing network structures and revenue streams
- Integrated multi-service access for TDM and packet-based traffic. This includes the ability to aggregate and transport multiple services with bit-rate and protocol transparency over a common network architecture
- The ability to separate TDM traffic from packet-based traffic to satisfy Quality-of-Service requirements
- Seamless integration of the access, edge and core networks

Ever since the deployment of digital telecommunications, improved transport efficiency at lower cost has been the driving force behind the evolution of network architectures. Since the 1980s SONET/SDH has grown rapidly, becoming the de facto mechanism to efficiently transport large volumes of circuit-switched traffic over the core network. The success of SONET/SDH within the core ensured that it was adopted within the MAN, where it now dominates. But in a world of ever-increasing bandwidth usage within the core network, and higher-bandwidth applications originating from the user, pressure on the MAN is growing.

And the MAN has now become the traffic bottleneck. Salvation is a new breed of optical transport device that promises to break the bottleneck between the user and the network core. Moreover, these devices promise to bring core bandwidth and switching intelligence right to the network edge.

Next generation aggregation platforms

These new devices are SONET and SDH-based platforms that aggregate lower bit-rate protocols to various higher bit-rate SONET/SDH and/or DWDM signals. In addition, they provide switching and grooming of TDM and multi-protocol packet-based traffic. This "next generation" (NG) SONET and SDH equipment has already been successfully developed by network equipment manufacturers (NEMs) who see it as the key revenue segment of the SONET/SDH market.

According to recent industry reports, NG equipment captured four percent of the nearly $20 billion SONET/SDH market in 2000. It is predicted that NG equipment will continue to capture market share from traditional SONET/SDH equipment to around forty percent of the nearly $45 billion SONET/SDH market by 2005.

NG platforms should create the necessary paradigm shift in metro switching as myriad possibilities emerge for the service provider. Not only do they provide a platform to support TDM services, but they also provide packet-mode services (such as Ethernet, IP and ATM) over high-speed optical line rates along with DWDM. What's more, they deliver this at much lower cost than a traditional SONET/SDH solution.

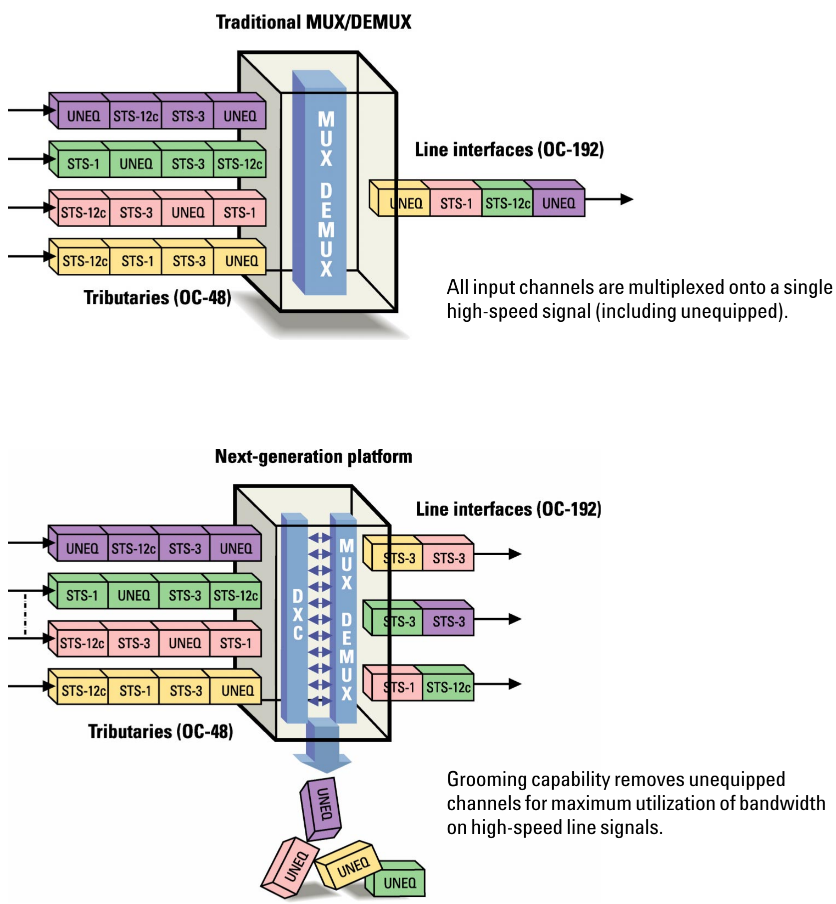

Figure 1: Network element evolution

NG platforms can be segmented into two distinct categories: those designed for the metro core, and those designed for the metro edge.

Metro-edge NG platforms

The heterogeneous mix of traffic types, protocols, and multi-layer-processing calls for advanced platform architecture in the metro edge. Metro-edge platforms focus primarily on aggregating, switching and grooming TDM and multi-protocol packet-based traffic. These platforms are often referred to as multi-service provisioning platforms (MSPPs). In brief, an MSPP is a data-aware SONET/SDH add-drop mux with grooming and multi-layer switching intelligence. In addition, some of the more adventurous vendors are also integrating edge switching and routing functionality (with layer 2 switching and layer 3 routing) to further enhance the value delivered by these devices. By supporting many physical and logical interfaces, a single NG device will allow the service provider to integrate many existing devices in the edge network. These NG devices provide the ability to rapidly provision and manage new packet-based services, squeeze more out of existing network resources, and protect high-margin TDM traffic. In conclusion, they provide ideal solutions for aggregating heterogeneous multi-protocol traffic at the network edge, ensuring fully packed fiber for transport across the MAN.

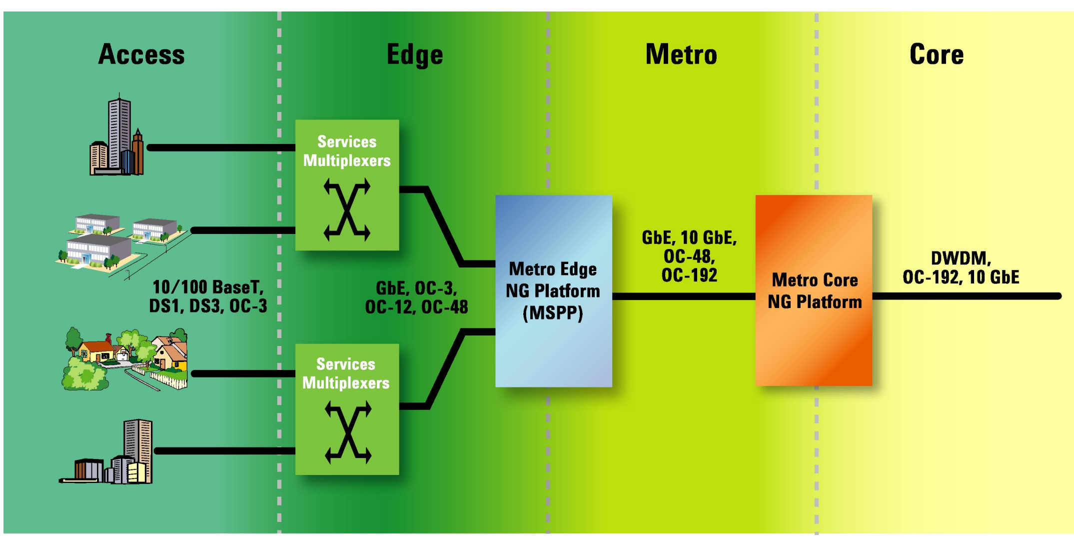

Figure 2: Deployment of NG platforms within the network

Metro-core NG platforms

Interfacing to the core network, however, is the job of the metro-core platforms. Their primary task is to cost-effectively transport mass amounts of traffic onto the core network, while scaling to meet the unpredictable demands of the traffic streaming through the MAN. These platforms provide a scalable bridge between high bandwidth TDM and IP-based core networks and the medium-bandwidth metro edge where all of the aggregation and switching takes place. They typically come in two basic flavors: SONET/SDH, or DWDM. Generally, these switches focus less on intelligence and more on mass transport and scalability. They are also most effective and economical when they are fed pre-groomed input signals. This combined synergy of intelligent aggregation at the metro edge, plus efficient input traffic, ensures expensive switch ports are effectively utilized. And this provides the service provider with a streamlined switching solution that saves money, increases margins, and conserves bandwidth for other paying customers.

All-channel testing technology

To ensure successful and efficient deployment of NG network elements, test methods now need to be rethought. This means a move away from port testing to path testing. That's because an NG platform switches data at the path level, decomposing the incoming signals and performing path-level processing (switching and grooming) prior to outputting the traffic. To efficiently test these network elements at the path level requires a test solution that has the capability to simultaneously monitor the performance of all the paths instantaneously.

As the nature of NG platforms is to aggregate the multi-protocol traffic, an OC-192 output signal, for example, could have a non-uniform payload structure containing a mix of STS-1 to STS-48c channels. For example, the signal could contain forty-eight STS-1 channels and three STS-48c channels, totaling fifty-one sub-rate signals. When a bit error ratio (BER) test is performed on the OC-192 signal, and errors are determined, the question is: which of the fifty-one sub-rates is the source of the error? Traditionally, a technician using a conventional test solution would test each of the sub-rates sequentially, one by one, until the error signal was discovered.

Given that a single BER test itself may take hours, finding the error within fifty-one signals could prove very costly in technician man-hours, network down time and, worse, customer dissatisfaction. Of course, as the volume and diversity of traffic expands, quick provisioning, fast commissioning and the need for service differentiation must be considered if the demands of the customers are to be satisfied.

A test solution needs the capability to simultaneously monitor all channels for error, alarm and pointer activity while additionally providing decoded information on the type of traffic being carried within the optical signal. It should also be possible to quickly and efficiently determine the integrity of the network element without time-consuming and complex test procedures. And better still, imagine that essential network performance information is presented both simply and clearly, helping technicians at every level solve network problems fast. Figure 3 shows how network performance is typically presented as a screen display.

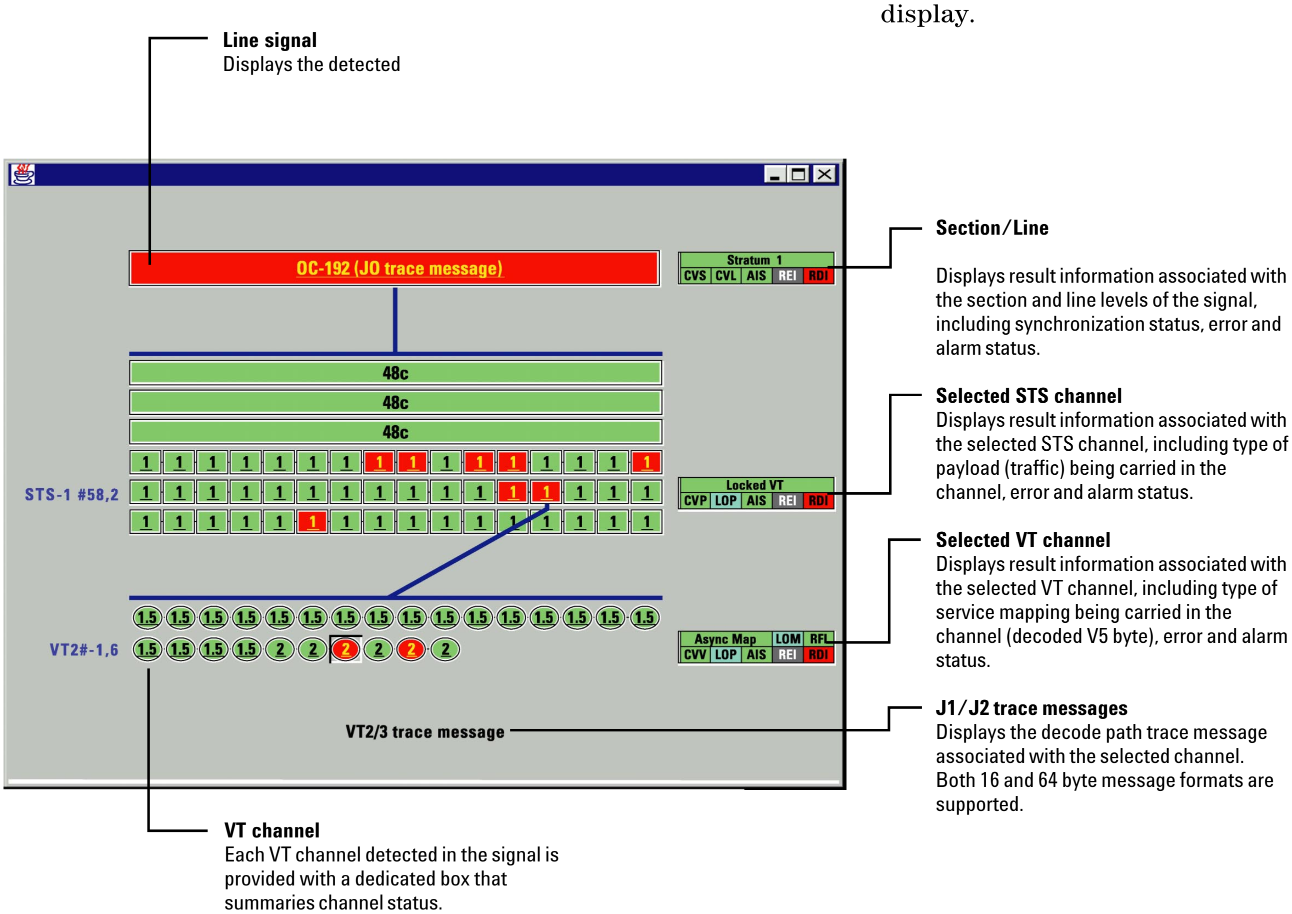

Figure 3: All-channel testing technology

In this example screen display a VT-structured STS-1 channel within the SONET line signal is carrying a fault. By viewing the full signal structure, it is possible to navigate to the fault using the supporting error and alarm information. The VT channel carrying a fault is clearly identified with information relating to the type of mapping being carried within the channel, along with error and alarm status.

Conclusion

Although the evolution of telecommunications has enforced a new set of rules on service providers, those adopting the paradigm of NG intelligent switching will have distinct advantages: providing the ability to provision traffic faster at the metro edge, and providing scalable, flexible and efficient transport within the metro core. In short, this makes bandwidth both cheaper and more manageable. And with the addition of NG test equipment, comprehensive testing of these network devices has become a viable proposition.

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